

Translation

PATENT COOPERATION TREATY

PCT/DE2003/002586



PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 2002P12242WO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/DE2003/002586	International filing date (day/month/year) 31 July 2003 (31.07.2003)	Priority date (day/month/year) 31 July 2002 (31.07.2002)
International Patent Classification (IPC) or national classification and IPC H01L 41/09		
Applicant SIEMENS AKTIENGESELLSCHAFT		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 25 February 2004 (25.02.2004)	Date of completion of this report 12 November 2004 (12.11.2004)
Name and mailing address of the IPEA/EP	Authorized officer
Facsimile No.	Telephone No.

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International application No.

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I. Basis of the report

1. With regard to the elements of the international application:*

- ☐ the international application as originally filed
- ☒ the description:
 pages _____ 1-15 _____, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____
- ☒ the claims:
 pages _____ 1-17 _____, as originally filed
 pages _____, as amended (together with any statement under Article 19
 pages _____, filed with the demand
 pages _____, filed with the letter of _____
- ☒ the drawings:
 pages _____ 1/4-4/4 _____, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____
- ☐ the sequence listing part of the description:
 pages _____, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/fig _____

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rule 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

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V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	2-17	YES
	Claims	1	NO
Inventive step (IS)	Claims	2-17	YES
	Claims	1	NO
Industrial applicability (IA)	Claims	1-17	YES
	Claims		NO

2. Citations and explanations

1. Reference is made to the following documents:

D1: DE 39 16 539 A1

D2: EP 0 954 037 A1.

2. The present application fails to meet the requirements of PCT Article 33(1) because the subject matter of claim 1 lacks novelty within the meaning of PCT Article 33(2).

Document D1 discloses (the references between parentheses relate to said document) a stacked piezoelectric multilayer actuator with at least two electrode layers and at least one piezoceramics layer therebetween and with a pretensioning device (page 2, lines 27-39). Disc springs are used for pretensioning. Intrinsic to the design of disc springs is an annular support surface and a further support surface, the diameter of said surfaces being less than the overall diameter. Thus, regardless of the orientation of the spring, the surface via which force is applied using a disc spring of this type is smaller than the overall diameter of the arrangement

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because, in particular, the diameter of the spring increases when it is compressed. Thus, implicitly, the volume to which the force is applied is also a partial volume of the piezoelectric layer. In addition, force is applied to a further surface on the side of the piezo actuator opposite the sealing element, where a cylinder piston that is inserted into a cylinder bore - which adjoins the piezo actuator locating bore and is somewhat smaller in cross-section than said locating bore - is adjacent to the piezo actuator (page 2, lines 40-44). It can therefore be assumed that the support surface, likewise, is somewhat smaller than the overall surface of the actuator transversely to its stack direction.

In particular, since the relative term "smaller", used in claim 1 of the present application, is not more closely defined, the subject matter of said claim is not adequately delimited from the prior art.

3. The combination of features in dependent claim 2 is not known from the available prior art, nor is it rendered obvious thereby. The reasons are as follows:

Claim 2 of the present application differs from the disclosure of D1 in that, in the present application, force is applied via multiple partial surfaces to the piezoelectric layer.

The subject matter of claim 2 is therefore novel (PCT Article 33(2)).

The technical problem can consequently be regarded as that of increasing the piezo actuator stroke, using appropriate measures to increase the d_{33} value of the actuator.

According to the present application, the problem is solved in that applying a force, via specific surfaces, to partial volumes of the piezo electric layer causes a switch in the direction of polarisation transversely to the piezoelectric layer and, as a result, the piezoelectric layer can be elastically deformed. Furthermore, by appropriately arranging and matching said areas of force application, the layer thickness and the applied force, a ferroelectric permanent deformation can be imposed.

In this way, it is possible for the stroke resulting from the creation of tension to be generated from the reduced permanent deformation and the increased layer thickness by means of both 90° domain switching and the piezoelectric effect.

Since, in D1, force is applied (pretensioning) for the purpose of path and pressure transmission and not specifically for improving the function of the piezo actuator *per se* and since, moreover, said document in no way suggests the application of force via a plurality of partial surfaces of a piezoelectric layer of the actuator, the subject matter of claim 2 of the present application is not suggested by D1 and is therefore inventive (PCT Article 33(3)).

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The combinations of features disclosed in the remaining dependent claims, claims 3-14, represent further embodiments of a piezo actuator of the above type and, in consequence, meet the requirements of the PCT in respect of novelty and inventive step.

Method claims 15-17, likewise, satisfy the requirements of the PCT in respect of novelty and inventive step, in particular in that it is explicitly indicated in claim 15 that, by applying force to a partial volume of the piezoelectric layer, polarisation can be induced transversely to the stack direction. This is not disclosed in document D1.

4. D2 relates to a piezoelectric actuator for a servo drive, said actuator being pretensioned by means of springs. Since D2 contains nothing to suggest that force could be applied via partial surfaces or that the problem as stated in the present application is solved, said document does not anticipate the substantive matter of the present application.
5. Industrial applicability in the technical field of piezo actuators can be acknowledged.
6. It is pointed out that, according to the description (see page 1, line 34 to page 2, line 2), it would appear from US 6 274 967 (same patent family as D2) that domain switching is induced by the application of force and that the polarisation of the domains is preferably transversely to the direction in which force is applied. This reference is incorrect since

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the document in question contains nothing to suggest
the preferred direction of domain polarisation (PCT
Rule 5.1(a)(ii)).